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(54) An arrangement for projecting the image of a sighting mark onto a target

(57) The invention relates to an arrangement for projecting the image of a sighting mark onto a target e.g. for guiding a missile. The arrangement includes a laser generator (1) which illuminates a sighting mark (6) via an optical fibre (3) and an optical system (6) to form the image of the illuminated sighting mark on the target (8). The optical fibre has a principal purpose of making the beam more uniform transversly than when it leaves the laser generator, thereby ensuring uniform illumination of the sighting mark, and also has a secondary purpose of providing a flexible connection between the generator and the projection system which thereby reduces the bulk of the moving portion of the arrangement.

FIG.1

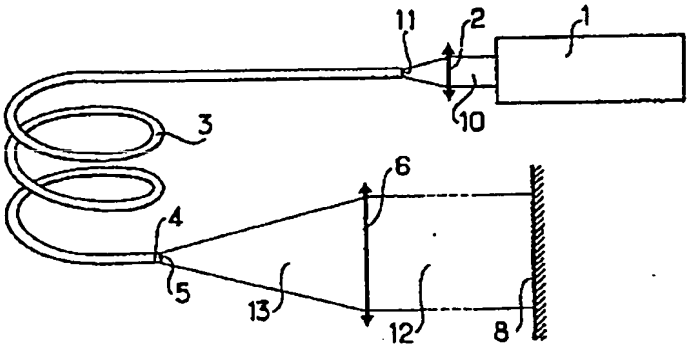

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FIG.1

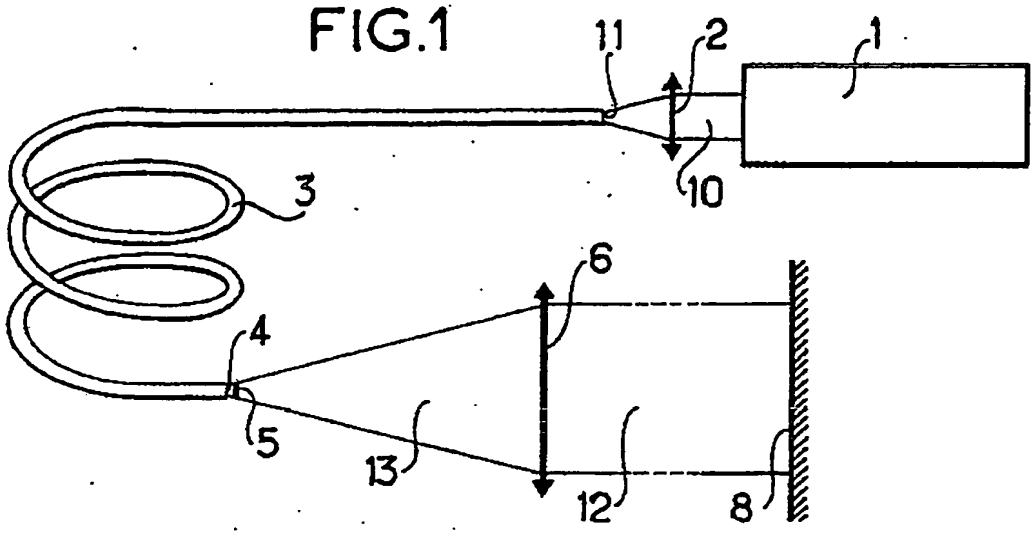


FIG.2

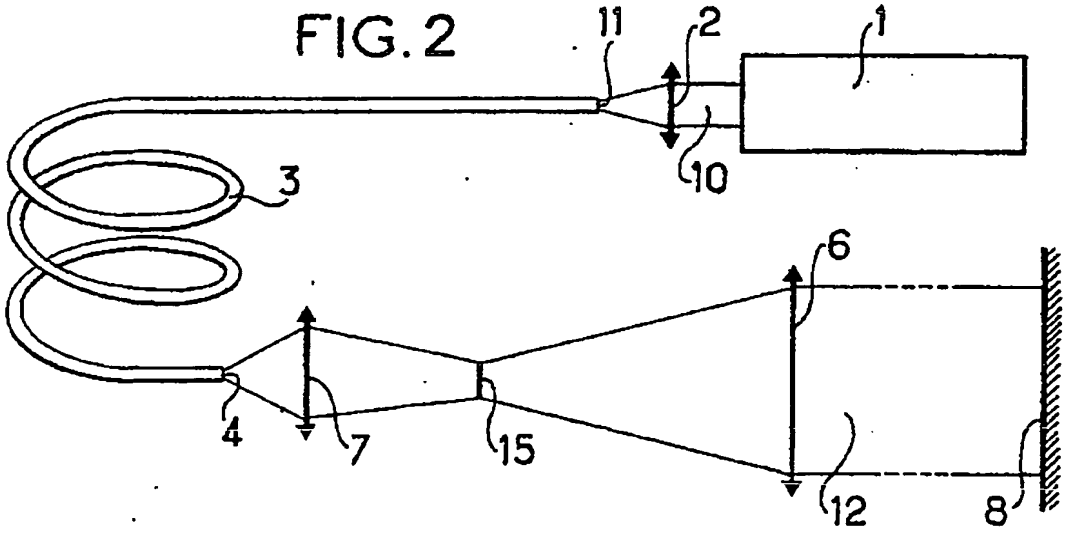
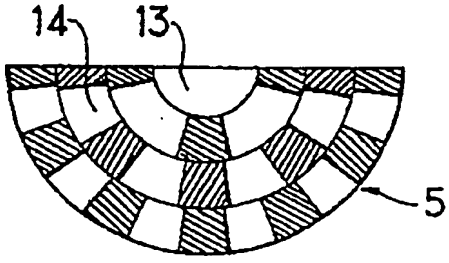


FIG.3



SPECIFICATION

An arrangement for projecting the image of a sighting mark onto a target

The present invention relates to an arrangement for projecting the image of a sighting mark onto a target and more particularly to an arrangement of this type which is capable of forming a beam for guiding missiles.

An arrangement is known for projecting the image of a sighting mark onto a target. Said arrangement includes, in alignment on the same axis, a laser generator pointed towards the target, a sighting mark disposed in the form of a graticule at the output of the laser, and an optical system which is capable of forming an image of the illuminated sighting mark on the target. Said sighting mark has a plurality of sections which are alternately opaque and transparent so as to cause variations in light density in the cross-section of the beam which emerges from the optical system. Said beam is intended to guide a missile equipped with photoelectric detectors towards the target. Indeed, when the missile crosses the beam, the detectors deliver signals in response to the variation of the light density. These signals make it possible to determine the relative position of the missile with respect to the axis of the beam and to correct the path of the missile to direct it towards the target.

This arrangement has disadvantages. A laser beam is generally not transversely homogenous in the near field, while the sighting mark or graticule must be illuminated as homogenously as possible to obtain the required energy density variation in the beam. Further, said arrangement requires precise alignment between the laser, the sighting mark and the optical projection system.

Preferred embodiments of the present invention overcome these disadvantages.

The present invention provides an arrangement for projecting the image of a sighting mark onto a target, said arrangement including:

—a light beam source which points towards the target, said source including a laser generator and an optical fibre disposed so that a first of its ends receives the energy emitted by the laser generator, said light beam emerging from the other end of the optical fibre with a more uniform transverse energy distribution than when entering the fibre;

—a sighting mark disposed on the path of the light beam after leaving the optical fibre so as to be illuminated by said beam; and

—an optical projection system disposed to form an image of the illuminated sighting mark on the target.

Particular forms of the present invention are described hereinbelow by way of example with reference to the accompanying drawing in which:

—figure 1 illustrates schematically one embodiment of the arrangement in accordance with the invention;

—figure 2 illustrates schematically another embodiment of the arrangement in accordance with the invention; and

—figure 3 is a plan of a component of the arrangement illustrated in figure 1.

Figure 1 illustrates a laser generator 1, e.g. a laser generator of the continuous emission type, the active material thereof possibly being neodymium-doped yttrium aluminium garnet. The laser beam 10 emitted by the laser generator 1 is concentrated by an optical coupling system 2 of known type on the input surface 11 of an optical fibre 3. Preferably, the fibre is formed by a core constituted by a first type of glass surrounded by a cladding constituted by a second type of glass, the refractive index of the second type of glass being lower than of the first type of glass so that the refractive index of the fibre is discontinuous at the contact surface between the two types of glass. By way of indication, said fibre may be a few metres long (say 5 meters); its diameter may be about 0.5 mm; it may have an attenuation of a few dB per kilometre (say about 3 dB/km). The output surface 4 of the fibre 3 is disposed adjacent to a sighting mark 5 in the form of a graticule whose diameter is the same as that of the fibre 3. The sighting mark 5 is placed substantially at the focus of an optical projection system 6 which increases the cross-section of the beam emerging from the end 4 of the fibre 3. The widened beam 12 which emerges from the optical system 6 is pointed towards a target 8. The optical system 6 forms an image of the sighting mark on the target which is always remote from the apparatus, said image being sharp starting from a relatively short distance from the optical system. Preferably, the optical system 6 has a numerical aperture which is at least equal to that of the fibre 3 so as to collect the entire light beam which leaves said fibre.

Figure 3 is a plan of an embodiment of the sighting mark 5 which may be made of glass or of a plastics material and may have a semi-circular shape about an axis 13, said axis advantageously being disposed coincident with the optical axis of the optical system 6. As illustrated in the figure the sighting mark 5 includes concentric half-rings such as 14 formed by radial sections which are alternately opaque and transparent, the number of sections per half-ring increasing with the distance from the centre.

The arrangement illustrated in figures 1 and 3 operates as follows.

The non homogenous energy density in the cross-section of the beam 10 which emerges from the laser generator 1, as well as the beam which enters the fibre via the surface 11 after concentration by the optical system 2, varies according to the type of laser used, e.g. Gaussian laser. In contrast, it is observed that homogenous energy density is obtained over the area 4 when the fibre is long enough. Said homogeneity can be explained considering the fact that the beam transmitted by the fibre can be divided into a large number of rays which undergo numerous reflections on the walls of the fibre while following different optical paths.

Due to said homogenous illumination, the

sighting mark 5 makes it possible to obtain a beam 12 in whose cross-section there is a variation, in space, of the energy density, said variation corresponding to that determined by the alternately opaque and transparent sections of the sighting mark which, in general, is rotated about the axis 13 so as to make the beam 12 rotate. The rotating beam can be used to guide a missile equipped with photoelectric detectors towards a target. Indeed, when the missile crosses the beam 12, it receives a sequence of optical signals which are transformed by the detectors into electric signals. In accordance with a known technique, these electric signals make it possible to determine the position of the missile with respect to the axis 13. The missile includes means for modifying its path towards the target as a function of the position data thus obtained.

In the case where the energy density on the sighting mark is too great and is liable to damage it, the variant embodiment illustrated in figure 2 is used. In said variant, the sighting mark 15 has a larger diameter than that of the fibre. A condenser optical system 7 is disposed to form an image of the end 4 of the fibre on the sighting mark 15 according to the enlargement necessary for said image to cover the entire surface of the sighting mark.

The arrangement in accordance with the invention has the following advantages.

Firstly, it makes it possible to illuminate the sighting mark 5 homogeneously regardless of how the energy in the cross-section of the laser beam is distributed in space.

Further, due to the fact that the optical fibre provides a flexible coupling, it is not necessary to align the laser emitter with the optical projection system. The portion of the apparatus which is to be pointed towards the target therefor includes only the end 4 of the fibre, the sighting mark and the optical projection system. This results in a reduction of the weight and of the bulk of said orientable portion.

CLAIMS

1. An arrangement for projecting the image of a sighting mark onto a target, said arrangement including:

—a light beam source which points towards the target, said source including a laser generator and an optical fibre disposed so that a first of its ends receives the energy emitted by the laser generator, said light beam emerging from the other end of the optical fibre with a more uniform transverse energy distribution than when entering the fibre;

—a sighting mark disposed on the bath of the light beam after leaving the optical fibre so as to be illuminated by said beam; and

—an optical projection system disposed to form an image of the illuminated sighting mark on the target.

2. An arrangement according to claim 1, also including an optical coupling system disposed to concentrate the energy emitted by the laser generator onto the first end of the fibre.

3. An arrangement according to claim 1, also including an optical condensing system disposed between the said other end of the fibre and the sighting mark to form an image of the said other end onto said sighting mark, said image completely covering the surface of the sighting mark.

4. An arrangement according to claim 1, wherein the numerical aperture of the optical projection system is at least equal to that of the fibre.

5. An arrangement according to claim 1, wherein the fibre is formed by a core constituted by a first type of glass surrounded by a cladding constituted by a second type of glass, the refractive index of the second type of glass being lower than that of the first type of glass.

6. An arrangement for projecting the image of a sighting mark onto a target, substantially as herein described with reference to the accompanying drawing.

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